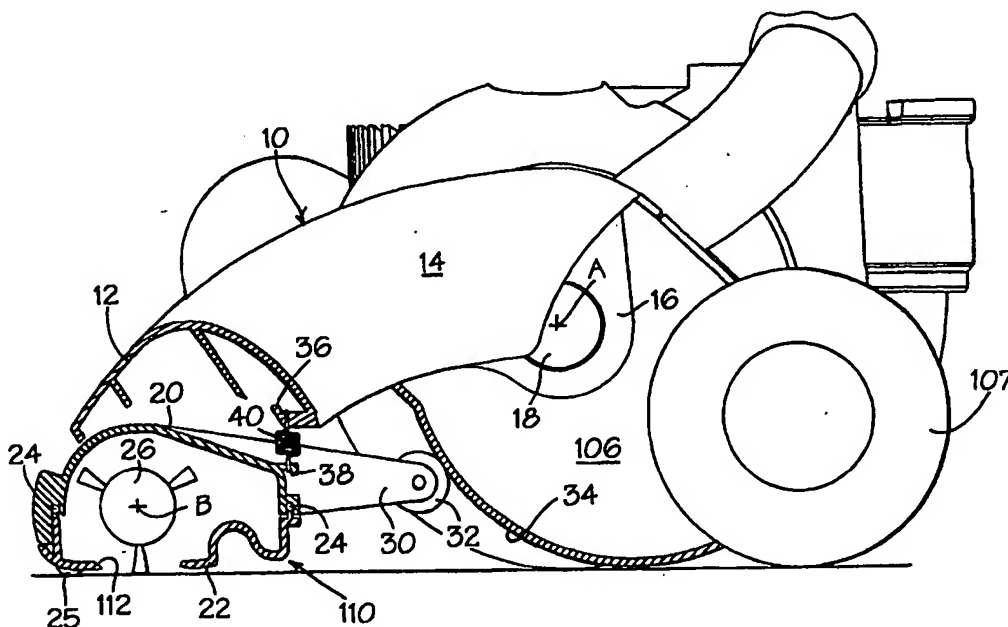


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: A CLEANER HEAD ASSEMBLY FOR A VACUUM CLEANER



## (57) Abstract

The invention provides a cleaner head assembly for a vacuum cleaner comprising a cleaner head body (10) rotatably mountable on the main body (102) of a vacuum cleaner (100), a brush housing (110) rotatably mounted on the cleaner head body (10) and having a dirty air inlet (112), a dirty air outlet and a brush bar (26) mounted in the dirty air inlet (112), wherein the brush housing (110) has a projecting arm (30) carrying a cam follower (32) for contacting a cam surface (34) located on the main body (102) of the vacuum cleaner (100), the cam surface (34) being adapted to maintain the dirty air inlet (112) in a horizontal plane. This maintains good suction through the cleaner head during cleaning.

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### **A Cleaner Head Assembly for a Vacuum Cleaner**

The present invention relates to a cleaner head assembly for a vacuum cleaner.

An upright vacuum cleaner normally comprises a main body containing dirt and dust separating apparatus, a cleaner head rotatably mounted on the main body and having a dirty air inlet, and a motor and fan unit for drawing dirty air into the dirt and dust separating apparatus via the dirty air inlet so that dirt and dust can be separated from the airflow before the clean air is expelled to the atmosphere. The dirty-air inlet through which dirty air is sucked into the vacuum cleaner is directed downwardly so that it faces the floor to be cleaned. The dirt and dust separating apparatus can take the form of a filter bag or, as is known, can alternatively take the form of a cyclonic arrangement. The present invention is not concerned with the nature of the dirt and dust separating apparatus and is therefore applicable to vacuum cleaners utilising either arrangement.

A brush bar is supported in the dirty-air inlet so that it protrudes to a small extent from the inlet. The brush bar is activated mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core from which bristles extend along its length in a radial direction. The brush bar is driven by the motor via a drive belt so that the brush bar rotates within the inlet. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust and pick up debris. The suction of air causes air to flow around the brush bar and underneath it to help lift the dirt and dust from the surface to be cleaned and then carry it from the dirty-air inlet to the dirt and dust separating apparatus.

It will be appreciated that the effectiveness of an upright vacuum cleaner will depend upon the amount of dirt and dust which can be picked up by the cleaner head and passed to the dirt and dust separation apparatus. For each vacuum cleaner there is an optimum configuration for the relationship between the dirty-air inlet and the carpet to be cleaned. Very often, the relationship will be one that maintains the dirty-air inlet in a plane which is parallel to the floor so that the mouth of the inlet is horizontal. Ideally then, the dirty

air inlet should be maintained completely horizontal to the floor so that the maximum amount of air is sucked into the dirty air inlet travels through the fibres of the carpet being cleaned before travelling on through the cleaner to the dirt and dust separating apparatus. However, the angle of the cleaner head to the horizontal may differ when the vacuum cleaner is used on different types of floor surface, eg on carpets with different piles and textures. Also, the vacuum cleaner is in use moved over the surface to be cleaned in reciprocating forwards and backwards movements so that the cleaner head travels both forwards and backwards over the surface whilst collecting dust and dirt via the dirty air inlet. In most cases the cleaner head will be acted upon in different ways by the carpet when it is travelling in different directions and will not maintain good contact on all sides of the dirty air inlet in both directions. Furthermore, the action of the user can result in the angle of inclination of the handle to the vertical being varied quite significantly during normal use and this can cause the plane of the dirty air inlet to be lifted, either at the front or the back, away from the horizontal. Any and all of these things can result in a reduction in the effectiveness of the suction of the cleaner head which can lead to a loss in the maximum level of pick-up and then to customer dissatisfaction.

Some attempts have been made to solve this problem by way of manually operated cleaner head lifting and lowering mechanisms by means of which the user is able to set the optimum height for the cleaner head when the cleaner is being used on a particular surface. However, these mechanisms only lift and lower the cleaner head by pivoting about the axis about which the cleaner head is connected to the main body of the cleaner. They do not address the problem of the dirty air inlet becoming inclined to the horizontal and thereby allowing the inlet suction to become less effective. One effective way to address this problem has been described in our copending UK patent application no. 9725777.8 which gives full details of a cradle-type arrangement for mounting the brush bar in the dirty air inlet. The brush bar is mounted in a cradle which is itself freely rotatably mounted in the cleaner head. The difficulty associated with this arrangement is that the cradle must be sealed with respect to the cleaner head and this can be difficult to achieve. The cradle must remain freely rotatable with respect to the cleaner head whilst preventing any loss of suction during use of the vacuum cleaner.

The constant movement of the cradle with respect to the cleaner head affects the life of the seal between the cradle and the cleaner head so that the seal can be prone to leakages in a relatively short time.

An object of the present invention is to provide a cleaner head which maintains the suction opening of the dirty air inlet in contact with the surface to be cleaned throughout cleaning. A further object of the invention is to provide a cleaner head assembly which remains horizontal during cleaning. A still further object of the invention is to provide a cleaner head for a vacuum cleaner which has improved pick-up capabilities. A further object is to provide a cleaner head assembly which requires less maintenance than known assemblies.

The present invention provides a cleaner head assembly as claimed in Claim 1. The invention also provides a vacuum cleaner as claimed in Claim 13. Preferred features are set out in the subsidiary claims.

The provision of a cam follower on the brush housing maintains the dirty air inlet in a substantially horizontal plane, irrespective of the type of carpet being cleaned, the direction of movement of the cleaner head and the angle of inclination of the handle to the vertical. The maintenance of the dirty air inlet in a horizontal plane ensures a good, even distribution of airflow through the inlet and around the brush bar. This in turn improves the pick-up performance of the cleaner head assembly.

The preferred arrangement of the brush housing being pivotable with respect to the cleaner head body about an axis coincident with that of the brush bar is a convenient and easily manufactured construction. Providing a biasing member between the cleaner head body and a rear portion of the brush housing ensures that the cam follower is maintained in contact with the cam surface at all times. This ensures reliable operation of the mechanism.

An embodiment of the invention will now be described with reference to the accompanying drawings, wherein:

Figure 1 is a side view of a vacuum cleaner incorporating a cleaner head assembly according to the present invention;

Figure 2 is a side view of the vacuum cleaner of Figure 1 with the handle shown in an inclined position;

Figure 3 is a sectional view of the cleaner head of the cleaner of Figures 1 and 2 in a first position;

Figure 4 is a sectional view of the cleaner head of the cleaner of Figures 1 and 2 in a second position; and

Figure 5 is a sectional view of the cleaner head of the cleaner of Figures 1 and 2 in a third position.

Figures 1 and 2 illustrate the overall construction of an upright vacuum cleaner incorporating a cleaner head assembly according to the invention. The vacuum cleaner 100 has a main body 102 in which dust separation apparatus 104 is housed. In this embodiment the dust separation apparatus 104 comprises cyclonic dust separation apparatus consisting of two cyclones arranged in series. Apparatus of this type is well known and will not be described any further here because it has no material effect on the invention. A motor housing 106 is located at the lower end of the main body 102 and forms part of the main body 102. Supporting wheels 107 are mounted directly on the side of the motor housing 106. A cleaner head assembly 108 is rotatably mounted on the motor housing 106 about an axis A. The cleaner head assembly 108 has a brush housing 110 with a downward facing inlet 112 arranged at the forward end of the cleaner head assembly 108. A flexible duct 114 extends between the brush housing 110 and a dirty air inlet in the main body 102 which communicates with ducting which leads to the dust separation apparatus 104.

A handle 116 extends upwardly from the lower part of the main body 102 and lies alongside the rear part of the main body 102. When the cleaner 100 is to be used in the upright mode (as shown in Figure 1), the handle 116 extends upwardly beyond the main body 102 so that it can be gripped by a user and used to manoeuvre the cleaner 100 across a surface to be cleaned. The handle 116 is, however, releasable and may alternatively be used as a hose and wand assembly. This can be achieved in several

ways and examples are shown and described in EP 0 037 674 and EP 0 134 654. The lower end of the hose/wand 116 is also connected via ducting 118 to the dirty air inlet of the main body 102 to allow dirt and dust entering the cleaner 100 via the hose and wand to be passed to the dust separation apparatus 104.

A changeover valve (not shown) is provided in order that the appropriate inlet can be automatically selected for different modes of operation. When the cleaner 100 is in the position shown in Figure 1, the changeover valve automatically connects the dust separating apparatus 104 to the wand and hose 116 so that cleaner can be used in cylinder mode for above the floor cleaning. Air is drawn into the cleaner through the distal end 116a of the wand which can be released from the cleaner for appropriate manipulation. The inlet 112 in the cleaner head assembly 108 is automatically shut off. When the cleaner 100 is to be used in conventional upright mode, the handle is restored to the position shown in Figure 1 and then inclined to the vertical as shown in Figure 2. The changeover valve automatically shuts off the air inlet at the distal end 116a of the wand and connects the dust separating apparatus 104 to the inlet 112 in the cleaner head assembly 108. The construction of the changeover valve does not form part of the present invention and will not be described any further here.

In all cases, ie in the upright mode and in the cylinder mode, a motor (not shown) located in the motor casing 106 drives a fan (also not shown) so as to draw air into the cleaner 100 via the appropriate inlet, conduct it to the dust separating apparatus 104 in the main housing 102 and then expel the cleaned air to the atmosphere. The cleaned air is preferably caused to flow past the motor so as to cool it before being expelled.

Figures 3 to 5 show in more detail the cleaner head assembly 108 forming part of the vacuum cleaner 100 shown in Figures 1 and 2. The cleaner head assembly 108 has a cleaner head body 10 comprising a front portion 12 extending laterally across the width of the vacuum cleaner 100 and two rearwardly extending side arms 14 extending rearwardly from the side portions of the front portion 12. Each side arm 12 has a lug 16 which defines an aperture centred on the axis A about which the cleaner head assembly 108 is pivotably mounted on the motor casing 106. The cleaner head assembly 108 is

mounted on the motor casing by way of pins 18 which extend through the apertures in the lugs. The cleaner head assembly 108 pivots freely about the axis A so as to "float" on the floor to be cleaned without requiring the user to identify and set a predetermined level at which the cleaner head must operate.

The cleaner head assembly 108 includes a brush housing 110. The brush housing 110 is pivotably mounted on the front portion 12 of the cleaner head body 10 by way of lugs (not shown) depending from the side portions of the front portion 12. The brush housing 110 is manufactured from an upper plate 20 and a lower plate 22 which may be made from plastics material or a metal such as stainless steel. The upper and lower plates 20, 22 are joined together by quarter turn fasteners (not shown), by press-fitting or by other suitable means. A seal 24 is trapped between the upper and lower plates 20, 22 so as to ensure that the seal between the plates 20, 22 is essentially airtight. Rollers 25 are rotatably mounted at the front edge of the lower plate 22 to support the brush housing 110 on the carpet or other surface to be cleaned. The rollers 25 can be positioned at or adjacent the outer edges of the lower surface 22 or, alternatively, can extend either continuously or in a spaced manner across the entire width of the brush housing 110.

A suction opening 112 is formed in the lower plate 22. The suction opening 112 extends across the entire width of the brush housing 110. A brush bar 26 is rotatably mounted in the brush housing 110 so that the bristles of the brush bar 26 protrude slightly out of the suction opening 112. The axis B about which the brush bar 26 rotates is coincident with the axis about which the brush housing 110 is pivotably mounted on the front portion 12 of the cleaner head body 10. The brush bar 26 is arranged to be drivable by the motor of the vacuum cleaner 100 in a conventional manner, for example, by way of a drive belt. The upper plate 20 of the brush housing 110 has a connection point (not shown) for connecting the brush housing 110 to an air inlet (not shown) on the main body of the vacuum cleaner 100. A flexible tube (not shown) connects the connection point with the air inlet. The flexible tube is made of any suitable material, for example, rubber or plastics.



Extending rearwardly from the brush housing 110 is a projecting arm 30. The projecting arm 30 is fixedly connected to or formed integrally with the brush housing 110 and is located beneath one of the side arms 14 adjacent the motor housing 102 of the vacuum cleaner. A wheel or roller 32 is pivotably mounted for free rotation on the distal end of the rearwardly projecting arm 30. A cam surface 34 is formed into the surface of the motor casing 106 facing the brush housing 110. The projecting arm 30 is located so that the wheel or roller 32 touches the cam surface 34 of the motor housing 106. The wheel or roller 32 then acts as a cam follower.

A hooked projection 36 is formed in the interior of the front portion 12 of the cleaner head body 10. A similar hooked projection 38 is formed on the rear portion of the brush housing 110. A resilient member 40 in the form of a tension spring is connected to both of the hooked projection 36, 38 and acts between the brush housing 110 and the cleaner head body 10 so as to bias them towards one another. This action ensures that the wheel or roller 32 remains in contact with the cam surface 34 at all times.

The shape of the cam surface 34 is specifically and deliberately designed to ensure that the brush housing 110 remains horizontal, or at least the suction opening 112 arranged in the lower plate 22 remains in a horizontal plane, at all angles of inclination of the handle 116 to the vertical. It will be appreciated that, because of the fact that the supporting wheels 107 are mounted directly on the side of the motor housing 106, the height of the axis A above the surface being cleaned changes with the angle of inclination of the handle 116. When the handle 116 is in a vertical position, as shown in Figure 3, the distance between the axis A and the profile of the cam surface 34 is sufficient to keep the projecting arm 30, and thereby the suction opening 112, substantially horizontal. As the handle 116 of the vacuum cleaner 100 is inclined with respect to the vertical during cleaning the wheels 107 are moved to a lower position with respect to the axis A so that the axis A is effectively lifted further away from the surface being cleaned. However, as is shown in Figure 4, the profile of the cam surface 34 is such that the distance between the axis A and the cam surface 34 is increased so as to maintain the wheel or roller 32 at the same level above the surface being cleaned as it was when the handle 116 was in a vertical position. The suction opening 112 is

therefore maintained in a horizontal plane and maximum performance is thus maintained. The same is true when the handle 116 is inclined even further away from the vertical as is shown in Figure 5. As the angle of inclination of the handle 116 increases, so the distance between the axis A and the cam surface 34 increases.

At all times, the tension spring 40 acts between the brush housing 110 and the cleaner head body 10 so as to bias the rear portion of the brush housing upwardly. The wheel or roller 32 is thereby maintained in constant contact with the cam surface 34 and is pressed thereagainst under the action of the spring 40. The spring 40 is under minimum tension when the handle 116 is in the vertical position.

Maintaining the suction opening in a horizontal plane maximises the efficacy of the cleaner head assembly during on the floor cleaning. The brush housing is no longer influenced by external factors such as differing carpet piles, direction of cleaner movement and differing angles of inclination of the handle to the vertical so that the brush housing can be tilted and the suction opening lifted away from the floor, at least on one side. Maintaining the suction opening in a horizontal plane maintains good suction through the fibres of the carpet being cleaned and thus maintains good pick-up by the cleaner head.

The invention is not limited to the precise details of the embodiment described above. It will be appreciated that the spring 40 can be replaced by any suitable resilient member such as a rubber or rubberised plastics band. Other variations and modifications will be apparent to a skilled reader.

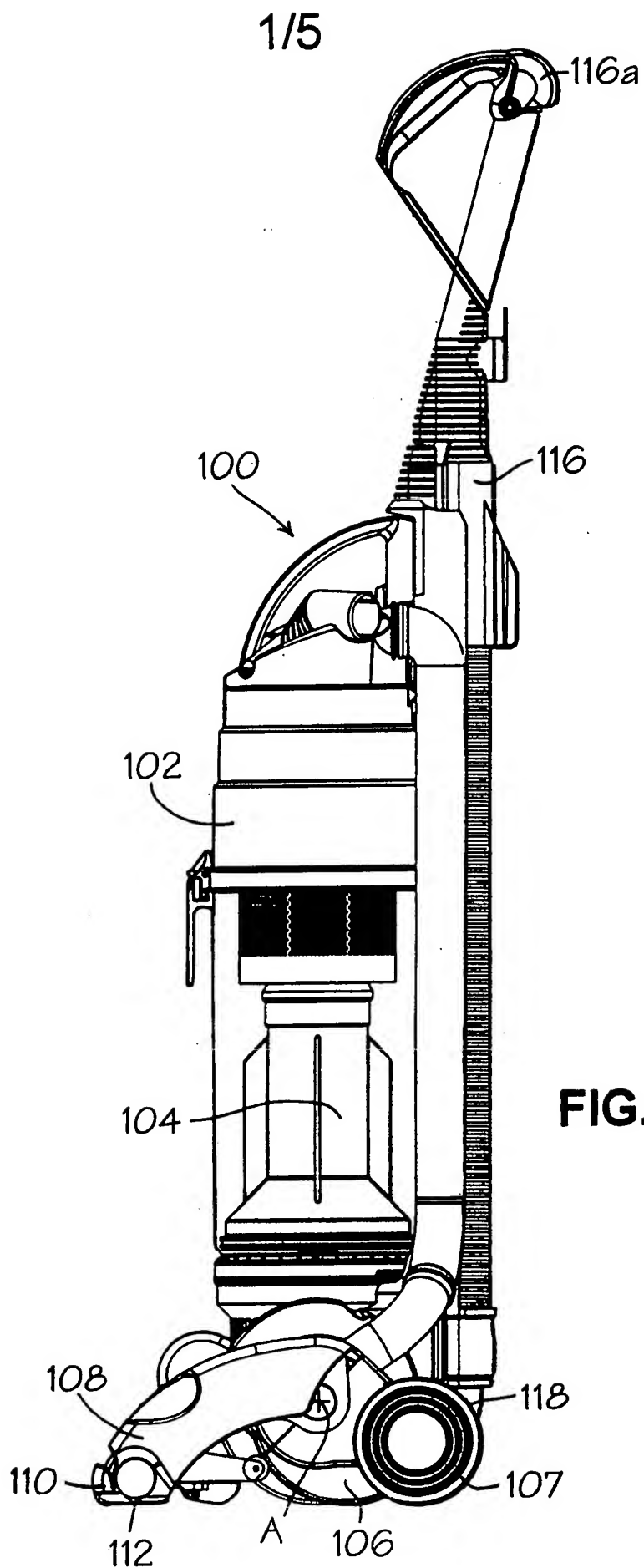
**CLAIMS:**

1. A cleaner head assembly for a vacuum cleaner comprising a cleaner head body rotatably mountable on the main body of a vacuum cleaner, a brush housing rotatably mounted on the cleaner head body and having a dirty air inlet, a dirty air outlet and a brush bar mounted in the dirty air inlet, wherein the brush housing has a projecting arm carrying a cam follower for contacting a cam surface located on the main body of the vacuum cleaner, the cam surface being adapted to maintain the dirty air inlet in a horizontal plane.
2. A cleaner head assembly as claimed in Claim 1, wherein the projecting arm carries a roller or wheel for rolling contact with the cam surface.
3. A cleaner head assembly as claimed in Claim 1 or 2, wherein the projecting arm extends rearwardly from the cleaner head body.
4. A cleaner head assembly as claimed in any one of the preceding claims, wherein the brush housing is pivotably mounted on the cleaner head about an axis coincident with that of the brush bar.
5. A cleaner head assembly as claimed in any one of the preceding claims, wherein the brush housing is pivotably mounted on the cleaner head body about an axis which is located forwardly of the centre of gravity of the brush housing.
6. A cleaner head assembly as claimed in Claim 5, wherein a biasing member extends between the cleaner head body and a rear portion of the brush housing and exerts an upward force on the rear portion of the brush housing.
7. A cleaner head assembly as claimed in Claim 6, wherein, in use, the biasing member maintains the cam follower in contact with the cam surface.

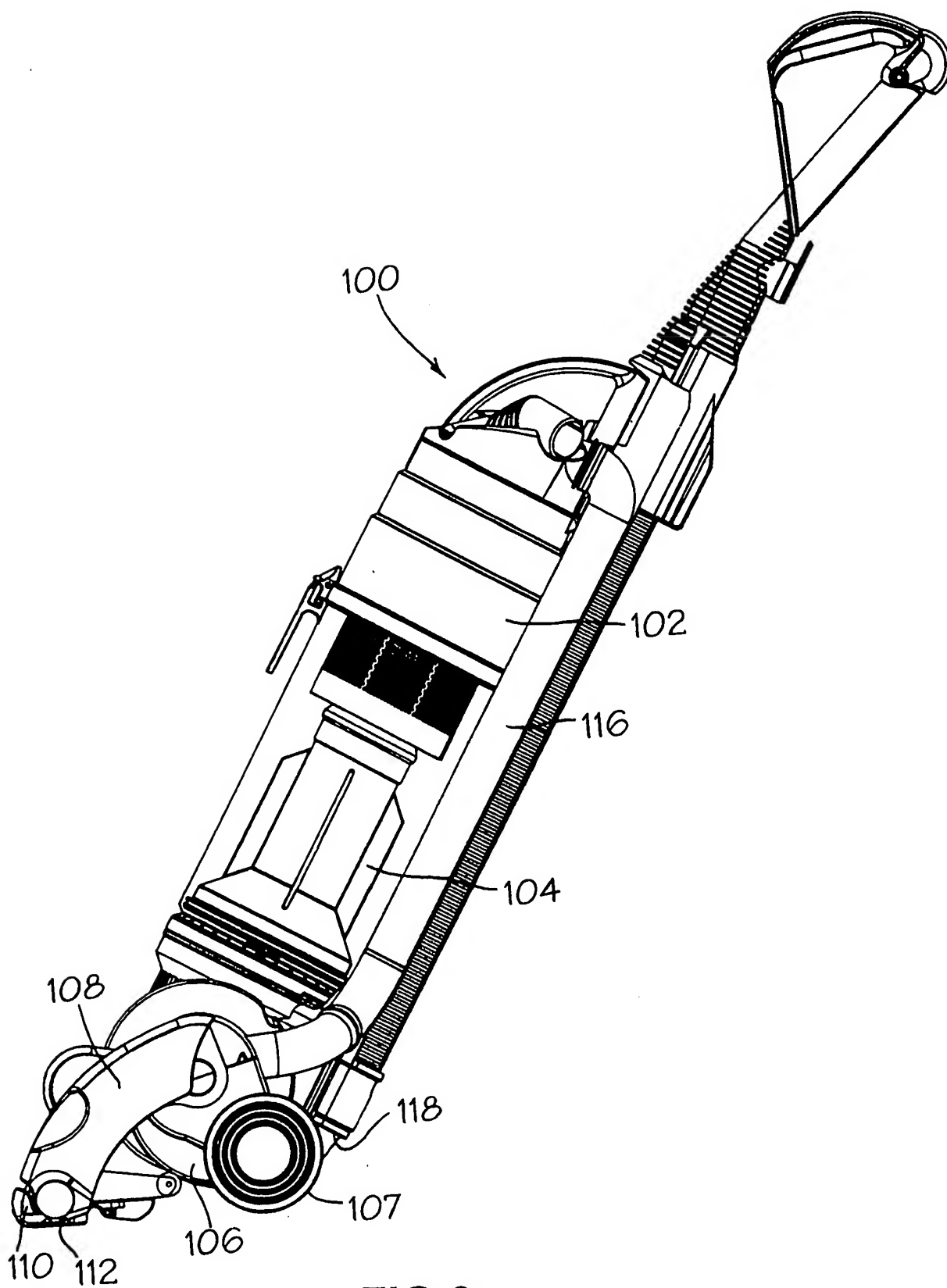
8. A cleaner head assembly as claimed in Claim 6 or 7, wherein the biasing member comprises a tension spring.
9. A cleaner head assembly as claimed in any one of the preceding claims, wherein the brush housing is sealed save for the dirty air inlet and the dirty air outlet.
10. A cleaner head assembly as claimed in Claim 9, wherein the dirty air outlet comprises a flexible tube connectable to a dirty air inlet in the vacuum cleaner main body.
11. A cleaner head assembly as claimed in Claim 10, wherein the flexible tube is separate from the cleaner head body.
12. A cleaner head assembly substantially as herein described with reference to the accompanying drawings.
13. A vacuum cleaner having a cleaner head assembly as claimed in any one of the preceding claims and a main body, wherein the main body of the vacuum cleaner has a lower portion which carries a cam surface.
14. A vacuum cleaner as claimed in Claim 13, wherein the cam follower is maintained in contact with the cam surface.
15. A vacuum cleaner as claimed in Claim 13 or 14, wherein the cam surface has a profile such that, in use, the dirty air inlet remains horizontal as the cam follower moves along the cam surface.
16. A vacuum cleaner as claimed in any one of Claims 13 to 15, wherein the main body comprises a dirty air inlet and the dirty air outlet of the brush housing is connected to the dirty air inlet of the main body.

17. A vacuum cleaner as claimed in any one of claims 13 to 16, wherein the main body contains cyclonic dirt and dust separating apparatus.

18. A vacuum cleaner substantially as herein described with reference to the accompanying drawings.



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**FIG. 2.**

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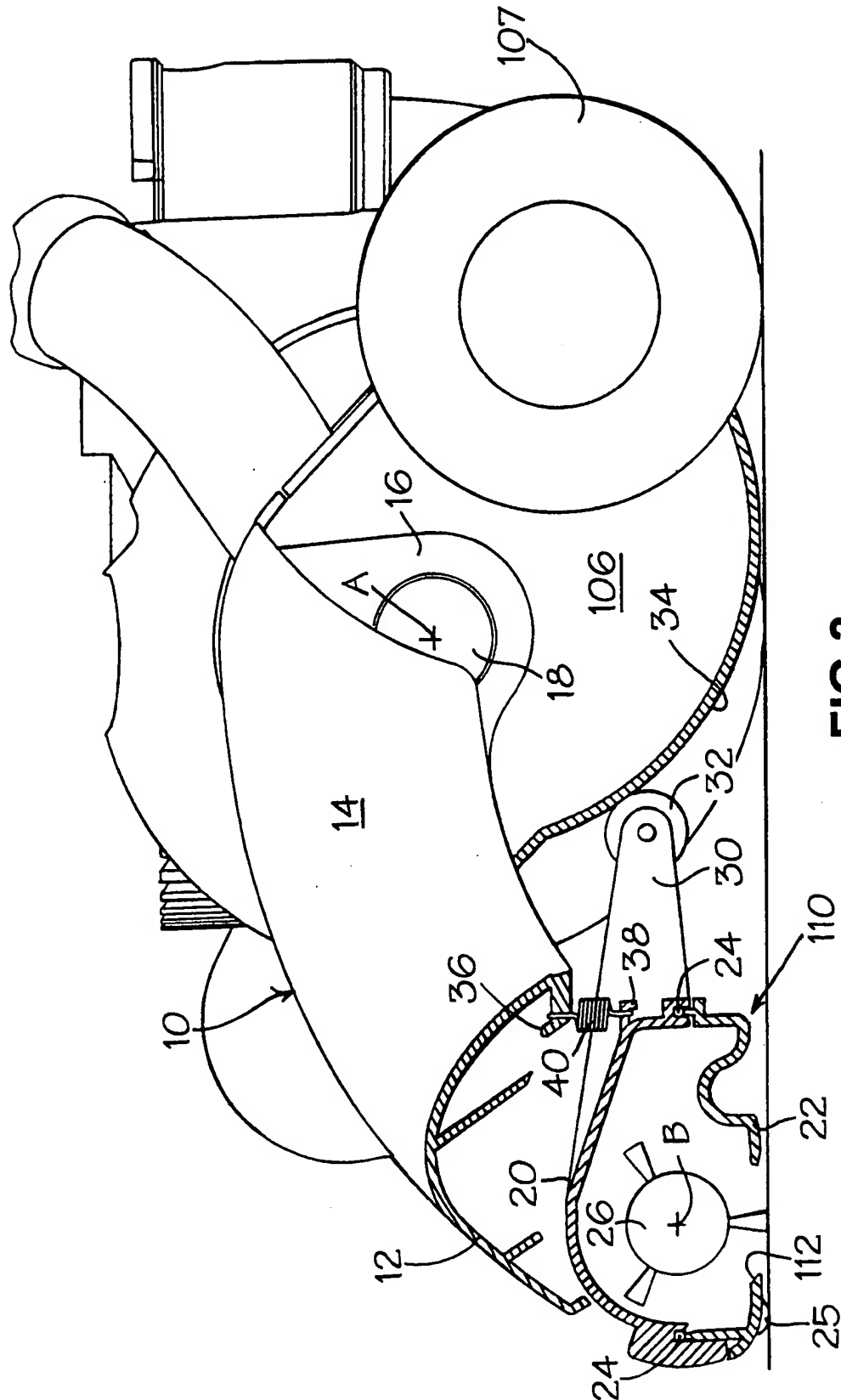
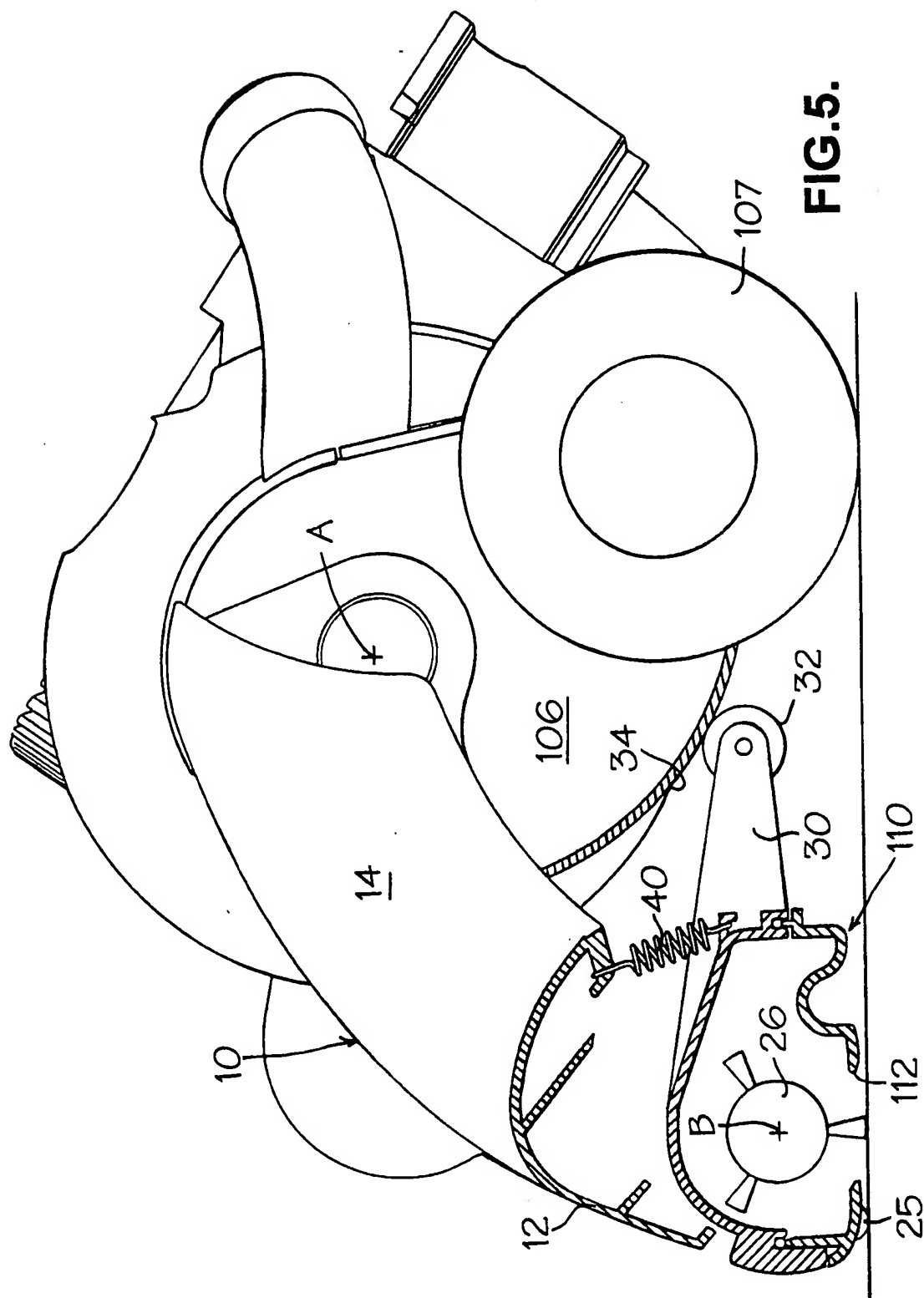


FIG. 3.





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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/03270

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 A47L9/04 A47L5/30

According to International Patent Classification (IPC) or to both national classification and-IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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☒ Further documents are listed in the continuation of box C.

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## INTERNATIONAL SEARCH REPORT

Inter. Appl. No.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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